Performance of Tropical Production and Processing Systems (PERSYST)

Diffusion Restreinte

REPORT ON THE MISSION

TO SIAT GABON

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7 to 19 December 2006

CIRAD-DPT A
Jean GUYOT

No. 2033-07
January 2007

Contents

Mission schedule

7 December: Departure from Kourou at 3 pm – Departure from Cayenne at 7 pm

8 December: Arrival at Orly at 7.15 am – Transfer to Roissy – Departure from Roissy at 11.45 pm

9 December: Arrival in Libreville at 6.10 am
Meeting with Mr Pierre Van de Beek and Mrs Marie Van de Beek
Departure for Mitzic at 11.45 am – Arrival at Mitzic at 6.15 pm
Meeting with Messrs Dutertre, Bois d'Enghein, Mbele

10 December: Partial tour of the estate – Establishment of an experimental protocol – start of mission report drafting

11 December: Start of tree marking for the ULV trials and the new Blocks-File
Telephone contact with Stamp Aéro - Discussion and validation of the protocol with Messrs Bois d'Enghein and Mbélé.

12 December: Marking of blocks for the Blocks-File - Preparation of computerized files for the inputting of data and score sheets

13 December: Further identification and marking of blocks for the ULV trial - Report drafting – drawing up of trial maps

14 December: Morning: Further identification and marking of blocks for the ULV trial
Afternoon: report drafting – drawing up of trial maps

15 December: End of trial marking. Training of Alexis Beka. Checking of the experimental protocol and of observation methods with the monitors – End of provisional report drafting and finalization of trial maps and observation sheets

16 December: Inspection of clone fields MZ AA 02 and MZ AA 03. Meeting with Messrs Dutertre, Bois d'Enghein and Mbele

17 December: Departure from Mitzic at 6.30 am – Arrival in Libreville at 1.45 pm - Meeting with Miss Vandebeek, Mr Bois d'Enghein and Mr Beyreau (Aéro Stamp)

18 December: Departure from Libreville at 11.15 am – Arrival at Paris CDG at 5.30 pm - Transfer to Orly

19 December: Departure from Paris at 11 am – Arrival in Cayenne at 3 pm – Arrival in Kourou at 5.45 pm.

People met

Mr Pierre Vandebeek	SIAT CEO
Miss Marie Vandebeek	Director, SIAT Gabon
Mr Patrice Dutertre	Director of the Rubber sector
Mr Pierre Bois d'Enghein	Mitzic site manager
Mr Alain Mbele	Head of Agriculture Service
Mr Beyreau	Aéro Stamp, pilot
Mr Sylvestre Mba	Tapping team leader, monitor
Mr Bernard Obiang	Special works team leader, monitor
Mr Alexis Beka	Monitor
Mr Bonjean Ntou'ou	Data inputter

Summary

The purpose of the mission was to make a phytosanitary inspection of the Mitzic estate, make recommendations for controlling leaf diseases, draw up an experimental protocol for ULV defoliant treatment and propose a system of general foliage monitoring at the estate.
In addition to those recommendations, the expert proposed that a clone trial be resumed and touched upon "parasitic phanerogams" and root diseases (with a view to new plantations), but no experimental protocol was set in place for those subjects.
The expert will ensure scientific monitoring of the trials set up. Two other missions have been requested by SIAT in 2007.

1 Scope of the mission

The aims of the mission were to:

- ascertain the condition of the foliage prior to artificial defoliation at the Mitzic estate, 2006-2007
- draw up a protocol for ULV treatment following the suggestions of the Stamp Aéro treatment company
- draw up a protocol for general plantation monitoring.

2 General comments

No records have been kept since 1998. The information given here therefore consists solely of general observations largely made through comparison with the last impressions remaining of the situation in 1998. There may therefore be a degree of subjectivity.

Overall, at first glance, the foliage in the plantation is quite mediocre. However, that impression might be deceptive and it will only be possible to assess foliage status, with figures, by monitoring a Blocks-File.
Mistletoes have developed very strongly, mostly *Phragmenthera capitata*, the most frequently found and most invasive species. It can be estimated that those parasites make up 50% of the canopy. They can break branches under their weight. However, some blocks have a satisfactory foliage density with few mistletoes (7/22, 7/23 ...).
Clone GT 1 is in a condition close to that which preceded the first defoliation operations: under 50% foliage with substantial heterogeneity (neighbouring trees either very leafy of totally defoliated). On the other hand, the foliage status of clones PB 235 and PB 260 has deteriorated in some plots. The foliage density is estimated at 50-60% but it is more uniform than for GT 1. Those two clones, which were still spared from mistletoes in 1998 are now as affected as GT 1.
Clone RRIM 600 still displays a difference between plots with quite dense foliage (block 5/20) and very defoliated blocks (block 2/6). As had already been seen, there is little mistletoe invasion. The secondary clones (PB 217 and AVROS 2037) also have mediocre foliage.

According to Mr Dutertre, 2005 (6 January to 15 January) was characterized by a very long and very dry main dry season (May-September). On the rubber trees, it resulted in substantial defoliation in October. Artificial defoliation, which involved the entire plantation (around 5,000 hectares), therefore affected a large proportion of quite young foliage. Nevertheless, that did not adversely affect defoliation. Refoliation occurred quite late, as the treatment date might have suggested. It took place in February/March and encountered rainfall that led to abundant young leaf fall. According to Mr Dutertre, the foliar status of the estate was less good in December 2006 than it was a year before.

The climatic situation in 2005 did not recur in 2006 and at the time of the visit the tree foliage was visibly old, suitable for artificial defoliation. However, two points may be a cause for concern:
- the effect of mistletoes on defoliation and refoliation is unknown

- most of the defoliant product will not be available before January 2007. There are plans to start treating around 7 January, meaning the treatment will be taking place around the same time as in 2006. That date is late, and even if defoliation is a success, refoliation is likely mostly to occur in March and lead to severe *Colletotrichum* attacks. Consequently, no great improvement should be expected in foliage condition in 2007. In future, the necessary steps must be taken to ensure that treatment begins on or around 20 December.

3 Experiments

SIAT has asked for two experiments to be designed and set up. The corresponding protocols can be found below.
Mr. Mbele, Head of the Agriculture Service (HAS), will supervise the monitoring of those two trials. Field observations will be carried out by two former "applied research" monitors who are very skilled in this type of monitoring: Sylvestre Mba and Bernard Obiang. A third monitor, Alexis Beka, who has come from tapping, has also been assigned. He was inexperienced in leaf disease observations and was therefore trained during the mission.
The monitors need to give observation sheets as soon as possible to the HAS, who will compare their observations with observations on the previous dates, prior to inputting, in order to correct very rapidly any wrong data. Bonjean Ntou'ou will be in charge of data inputting. The data files will be sent after each input to J. Guyot who will interpret the data.

The following points are drawn to the attention of the estate managers.

- Observations need to be carried out in the shortest time possible. However, it will involve 1,200 trees for each observation (+ 600 trees of the Blocks-File every three months). It will therefore be necessary to partly release the monitors from their usual work for around 3 days on the recording dates. It is therefore proposed that the ULV trial be observed every ten days, and the Blocks-File every three months.
- In order to optimize monitor work time, it will be necessary to ensure their transport between the sites and ensure that observation zones are maintained (clean planting rows and opening of passages through interrows and windrows).
- Observations should begin very early in the morning, since after 10.30 am the luminosity considerably hinders observations.
- An initial inspection of the ULV trial must be carried out before treatment, then 7 days after treatment, and then every 10 days. The Blocks-File will have to be inspected before treatment begins, or where necessary when natural defoliation begins.
- As far as possible, it is preferable for each replicate of the ULV trial always to be observed by the same monitor.
- Clipboards need to be provided for each monitor.

3.1. ULV trial

This trial arises from the proposal made by Stamp Aéro (the company chosen for the 2006-2007 treatment) to treat the plantation using a ULM at very low volume. Its aim is to test the efficiency of the technique. There are plans to test two ULV doses (5 and 10 litres spread per hectare) and a dose of 15 litres per hectare by aeroplane as an alternative solution should the ULV fail, thereby making it possible to reduce the volume spread per hectare and therefore the number of flights. According to Stamp Aéro, spreading 15 litres per hectare by ULM is technically feasible, but only 10 hectares can be treated per flight (150-litre tank). By

aeroplane, 40 hectares can be treated per flight at 15 l/ha (600-litre tank). The hourly cost of ULM treatment is cheaper than by aeroplane, but the increase in the number of flights compared to the aeroplane may go against that technique. A cost study would be relevant.
In 2005, Mist Control drift retardant (20 g/l of polyvinyl polymer) was used at a rate of 52 ml per hectare. The manufacturer (Miller Chemical and Fertilizer Co) has just been faxed to ascertain precisely the recommended doses, notably at low volume.

As the ULV trial is only supposed to be conducted over one year, the proposal made is quite hefty in terms of implementation, but it will lead to a recommendation as early as 2007. Stamp Aéro has also been asked to carry out this trial as soon as possible, if necessary before the industrial treatment.

3.2. Plantation monitoring

SIAT wishes to procure a system for regular monitoring of the estate. Severe mistletoe infestation prevents satisfactory foliage density assessment by the simple general scoring of blocks, so it is necessary to carry out precise monitoring of reference blocks.
A Blocks-File will therefore be established.

4 Additional comments

Clone field MZ AA 02 contains some clones that display good resistance to leaf diseases, particularly clone RRIC 100. Only that clone is being monitored for its yield, which seems to be promising, but it is difficult to compare the data with the yields of the other clones. This clone field could provide some valuable information for planting or replanting. Its condition is highly satisfactory (cleanness, tree density) and it is worth more rational monitoring, focusing on growth, yield and foliage condition. Clones of the future for the next plantations are undoubtedly to be found in that clone field. SIAT Gabon managers agree in principle to such monitoring, but need to solve the problem of monitor supervision.

Root diseases have spread very much since 1998. Tree mortality is high and there are vast clearings scattered across the estate. However, according to SIAT managers, tree density per hectare is still quite good (320 trees/ha). As the estate stands at the moment, any attempt to control root diseases would probably be in vain. On the other hand, the results obtained by CATH before 1998 and data from the bibliography may make it possible to adopt preventive techniques in zones to be planted or replanted.

The proliferation of mistletoes raises the question of their harmfulness. Some work on that subject has been carried out by a student, Mr Nestor Engone, who is completing his thesis on the topic. Those data will probably provide answers to this question. Failing that, the harmfulness of the parasites will have to be assessed in terms of rubber yields and foliage production capacity. There is no control method available at the moment. The report by Mr Engone indicates that mistletoe seeds can be parasitized by Diptera, as reported in Ivory Coast by J. Guyot.

Another mission by J. Guyot is scheduled for June or July 2007.

Results of observations in clone fields

MZ AA 02	Foliage density					
		R1	R2	R3	R4	Mean per clone
	GT 1	80	75	70	80	**76**
	IRCA 130	80		80	70	**77**
	IRCA 109	80	80	90	70	**80**
	RRIM 712	90	70	90	80	**83**
	IRCA 111	100	90	80	80	**88**
	RRIC 100	90	85	90	90	**89**
	Mean per replicate	**87**	**80**	**83**	**78**	

MZ AA 03	Foliage density	R1	R2	R3	R4	Mean per clone
	GT 1	40	70	80	80	**68**
	IRCA 18	60	70	70	80	**70**
	PB 254	60	70	70	80	**70**
	IRCA 27	70	80	70	70	**73**
	SCATC 7-20-56	60	70	90	90	**78**
	RRIC 100	80	70	90	80	**80**
	PB 260	80	80	90	80	**83**
	IRCA 126	90	70	90	90	**85**
	RRIC 132	100	90	90	90	**93**
	Mean per replicate	**71**	**74**	**82**	**82**	

MZ AA 03	Mistletoe score (0 to 3)	R1	R2	R3	R4	Mean per clone
	PB 260	1	0	0	1	**1**
	RRIC 132	1	1	0	1	**1**
	RRIC 100	1	0	1	1	**1**
	IRCA 27	2	0	1	1	**1**
	IRCA 126	1	1	1	2	**1**
	SCATC 7-20-56	2	0	1	2	**1**
	IRCA 18	2	2	2	1	**2**
	PB 254	2	2	3	2	**2**
	GT 1	3	2	3	3	**3**
	Mean per replicate	**2**	**1**	**1**	**2**	

Protocol for an ultra-low volume artificial defoliation trial (ULV 06)

The trial is intended to test the efficiency of ULV defoliant treatments.

The trial will comprise 5 treatments:

Name	Treatment	Volume CP per hectare	Volume of water per hectare	Volume of drift retardant per hectare
A	untreated control	None	None	To be defined in accordance with manufacturer's recommendations
B	5 l/ha ULM	3 litres	2 litres	
C	15 l/ha aeroplane	3 litres	12 litres	
D	control 30 l/ha aeroplane (reference 2005)	3 litres	27 litres	
E	10 l/ha ULM	3 litres	7 litres	

Each treatment will be applied on the three dominant clones in the plantation:

- GT 1
- PB 235
- PB 260

The trial will involve 4 replicates. Each replicate will correspond to a zone (pocket) of the estate containing the three clones planted the same year (or over two consecutive years at the most).
The first and final row of each treatment will be marked with a cross in black paint on the first tree.
Each elementary plot will comprise 12 consecutive rows 7.50 m apart and 250 m in length (100 trees at the time of planting).

The treatment date has yet to be defined.

Observations will be carried out in the 4 central rows (rows 5 to 8) in each elementary plot. The principle of the observations will be as follows: in order to form a border of around 25 metres, the first tree observed will be the 11th tree in row 5; then the following four will be observed. The sixth tree to be observed will be the 16th tree in row 6, then the following 4 trees; for row 7, trees 21 to 25 will be observed and, finally, in row 8 trees 26 to 30 will be observed (figure 1).
In practice, due to high mortality caused by root diseases and wind damage, responsible for wide clearings, this design will need to be re-arranged in numerous cases. The general principle will be maintained, but it will then be 5 consecutive trees that are observed, even if separated by empty spaces. If, when changing rows, the tree that is theoretically to be observed is missing, it will be the first tree present that will be observed. Lastly, some trees that are dying or too severely invaded by mistletoes for observation to be carried out will be

excluded from the record and considered missing. It may be necessary to begin observations before the 10th tree.

All the trees to be observed will be numbered with black paint.

Observation is to take place between 20 and 31 December, then every ten days from the 7th day following the treatment date, and up to the end of March 2007. For each tree, it will involve:

- the foliage density (scoring in tens in a range of 0 to 100) representing the proportion of foliage in place compared to the potential quantity. It will be necessary to disregard the part of the canopy occupied by mistletoes, which will be considered as missing and not defoliated
- the percentage of each leaf stage (A, B, C, D)
- the disease score: 0 = zero, 1 = low, 2 = average, 3 = high, 4 = very high (leaf fall)

It is essential that all items be recorded.

Data will be inputted by Bonjean Ntou'ou at Mitzic and will be sent in computer file form (Excell) to J. Guyot for analysis. It is important that observations be sent frequently (if possible after each inspection).

Ultra-low volume trial: distribution of replicates and treatments

GT1

Replicate	Block	Lines 1 à 12	Lines 13 à 24	Lines 25 à 36	Lines 37 à 48	Lines 49 à 60
1	8/7 East	Untreated control	ULM 5 l/ha	ULM 10 l/ha	Aircraft 30 l/ha	Aircraft 15 l/ha
2	16/16 West	Aircraft 15 l/ha	Untreated control	ULM 5 l/ha	Aircraft 30 l/ha	ULM 10 l/ha
3	5/28 East	ULM 5 l/ha	ULM 10 l/ha	Aircraft 30 l/ha	Untreated control	Aircraft 15 l/ha
4	12/11	Aircraft 30 l/ha	Untreated control	ULM 10 l/ha	Aircraft 15 l/ha	ULM 5 l/ha

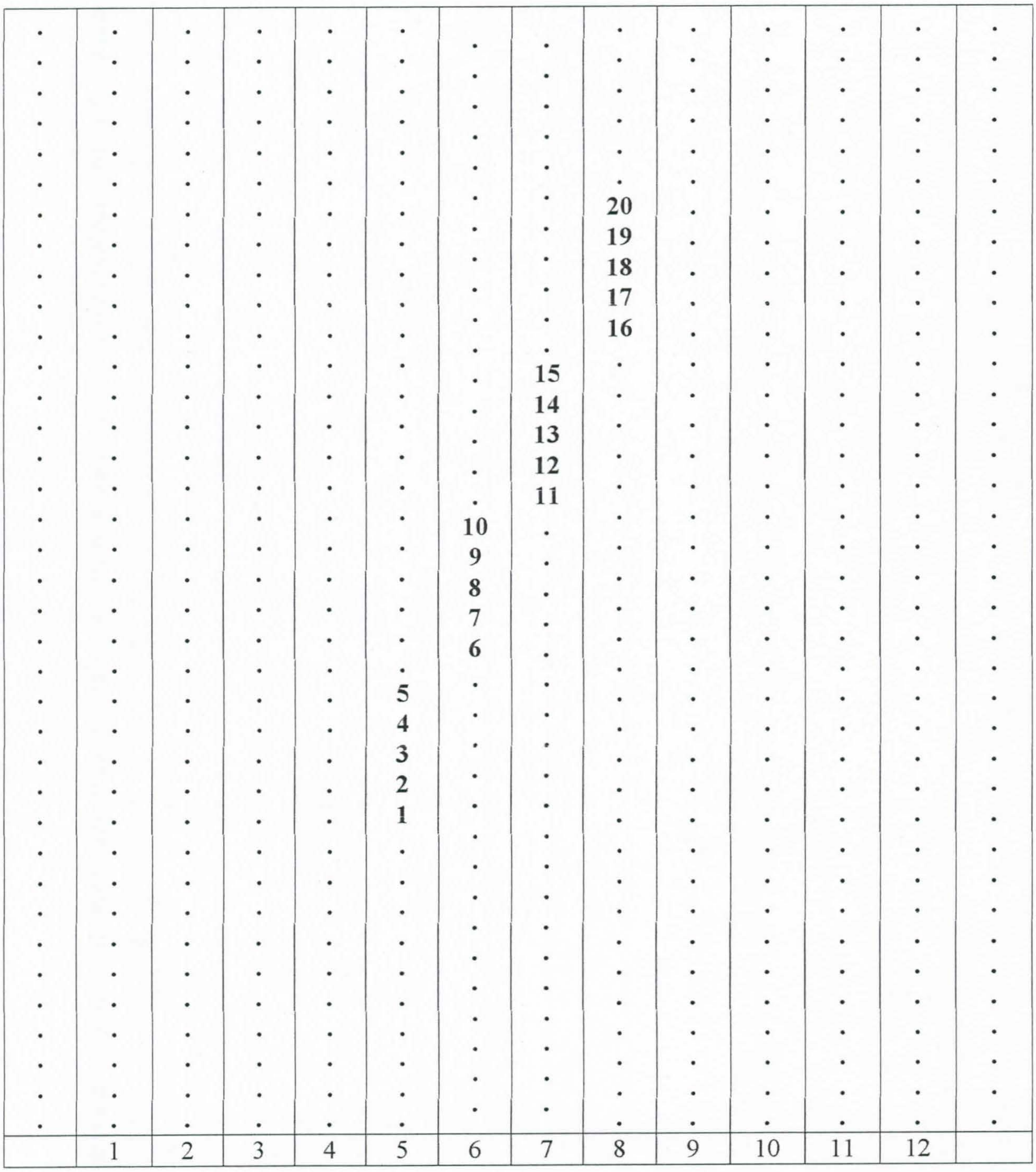
PB 235

Replicate	Block	Lines 1 à 12	Lines 13 à 24	Lines 25 à 36	Lines 37 à 48	Lines 49 à 60
1	6/5 East	Aircraft 15 l/ha	ULM 5 l/ha	Untreated control	ULM 10 l/ha	Aircraft 30 l/ha
2	17/16 West	Aircraft 30 l/ha	ULM 5 l/ha	Aircraft 15 l/ha	Untreated control	ULM 10 l/ha
3	5/26 West	Aircraft 15 l/ha	Untreated control	Aircraft 30 l/ha	ULM 10 l/ha	ULM 5 l/ha
4	13/11	Untreated control	ULM 5 l/ha	Aircraft 30 l/ha	ULM 10 l/ha	Aircraft 15 l/ha

PB 260

Replicate	Block	Lines 1 à 12	Lines 13 à 24	Lines 25 à 36	Lines 37 à 48	Lines 49 à 60
1	9/6 - 8/6 West	ULM 10 l/ha	Aircraft 30 l/ha	ULM 5 l/ha	Untreated control	Aircraft 15 l/ha
2	16/17 East	ULM 10 l/ha	Aircraft 30 l/ha	ULM 5 l/ha	Untreated control	Aircraft 15 l/ha
3	5/27 West	Aircraft 15 l/ha	Untreated control	Aircraft 30 l/ha	ULM 10 l/ha	ULM 5 l/ha
4	16/11	ULM 5 l/ha	Untreated control	ULM 10 l/ha	Aircraft 15 l/ha	Aircraft 30 l/ha

Diagram of the sampling principle to be respected



Protocol for Blocks-File monitoring

The purpose of the Bocks-File is regularly to indicate a general foliage situation for the whole plantation.
It comprises blocks that are representative of the different clones and planting years, excluding clones that are rare in the plantation.

Thirty-six blocks have been chosen. Some of them are included in the ULV trial. They are the observations carried out in the reference treatment (D = aeroplane 30 l/ha) which will be incorporated in 2006 and 2007 in the Blocks-File. Thereafter, it will be possible to add an extra 5 trees to establish a typical Blocks-File.
For the other 24 blocks, observations will be carried out every three months beginning in December 2006 on 25 trees in 5 consecutive rows following the same principle as in the ULV trial.

For each tree, the observations will involve:

- the foliage density (scoring in tens in a range of 0 to 100) representing the proportion of foliage in place compared to the potential quantity. It will be necessary to disregard the part of the canopy occupied by mistletoes, which will be considered as missing and not defoliated
- the percentage of each leaf stage (A, B, C, D)
- the disease score: 0 = zero, 1 = low, 2 = average, 3 = high, 4 = very high (leaf fall).

Composition of the 2006-2007 Blocks-File for Mitzic (the shaded blocks are part of the ULV trial).

BLOCK	CLONE	YEAR
2/3 East	GT 1	1982
6/11 West	PB 217	1983
5/11 West	PB 235	1983
1/0 East	GT 1	1983
5/16 West	PB 217	1984
5/19 East	GT 1	1984
4/20 West	PB 260	1984
3/20 East	GT 1	1984
5/20 East	RRIM 600	1984
7/20 West	GT 1	1984
2/12 East	GT 1	1984
2/7 West	GT 1	1984
2/6 West	RRIM 600	1984
1/5 East	GT 1	1984
8/23 East	GT 1	1985
11/16 East	PB 255	1985
14/14 East	GT 1	1985
3/22 West	PB 235	1989
2/24 East	GT 1	1990
11/22 West	PB 260	1990
14/17 Northwest	PB 260	1990
16/8 East	PB 235	1989
15/7 East	PB 260	1989
14/7 East	GT 1	1989
6/5	PB 235	1988
9/6	PB 260	1988
8/7	GT 1	1989
16/16	GT 1	1990
16/17	PB 260	1990
17/16	PB 235	1990
5/26	PB 235	1989
5/27	PB 260	1989
5/28	GT 1	1990
13/11 East	GT 1	1986
13/11 West	PB 235	1986
16/11 West	PB 260	1986

Annexes

ULV trial observation sheets

TRIAL ULV 06 CLONE REPLICATE DATE
MONITOR BLOCK

TREATMENT	LINE	TREES	LEAF DENSITY	PERCENTAGE OF LEAF STAGES				DISEASE SCORE
				A	B	C	D	
A	1	1						
A	1	2						
A	1	3						
A	1	4						
A	1	5						
A	2	6						
A	2	7						
A	2	8						
A	2	9						
A	2	10						
A	3	11						
A	3	12						
A	3	13						
A	3	14						
A	3	15						
A	4	16						
A	4	17						
A	4	18						
A	4	19						
A	4	20						

TREATMENT	LINE	TREES	LEAF DENSITY	PERCENTAGE OF LEAF STAGES				DISEASE SCORE
				A	B	C	D	
B	1	1						
B	1	2						
B	1	3						
B	1	4						
B	1	5						
B	2	6						
B	2	7						
B	2	8						
B	2	9						
B	2	10						
B	3	11						
B	3	12						
B	3	13						
B	3	14						
B	3	15						
B	4	16						
B	4	17						
B	4	18						
B	4	19						
B	4	20						

TRIAL ULV 06 CLONE REPLICATE DATE
MONITOR BLOCK

TREATMENT	LINE	TREES	LEAF DENSITY	PERCENTAGE OF LEAF STAGES				DISEASE SCORE
				A	B	C	D	
C	1	1						
C	1	2						
C	1	3						
C	1	4						
C	1	5						
C	2	6						
C	2	7						
C	2	8						
C	2	9						
C	2	10						
C	3	11						
C	3	12						
C	3	13						
C	3	14						
C	3	15						
C	4	16						
C	4	17						
C	4	18						
C	4	19						
C	4	20						

TREATMENT	LINE	TREES	LEAF DENSITY	PERCENTAGE OF LEAF STAGES				DISEASE SCORE
				A	B	C	D	
D	1	1						
D	1	2						
D	1	3						
D	1	4						
D	1	5						
D	2	6						
D	2	7						
D	2	8						
D	2	9						
D	2	10						
D	3	11						
D	3	12						
D	3	13						
D	3	14						
D	3	15						
D	4	16						
D	4	17						
D	4	18						
D	4	19						
D	4	20						

TRIAL ULV 06 CLONE REPLICATE DATE
MONITOR BLOCK

TREATMENT	LINE	TREES	LEAF DENSITY	PERCENTAGE OF LEAF STAGES				DISEASE SCORE
				A	B	C	D	
E	1	1						
E	1	2						
E	1	3						
E	1	4						
E	1	5						
E	2	6						
E	2	7						
E	2	8						
E	2	9						
E	2	10						
E	3	11						
E	3	12						
E	3	13						
E	3	14						
E	3	15						
E	4	16						
E	4	17						
E	4	18						
E	4	19						
E	4	20						

Blocks File observation sheets

CLONE
DATE
BLOCK

MONITOR

TREES	LEAF DENSITY	PERCENTAGE OF LEAF STAGES				DISEASE SCORE
		A	B	C	D	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
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17						
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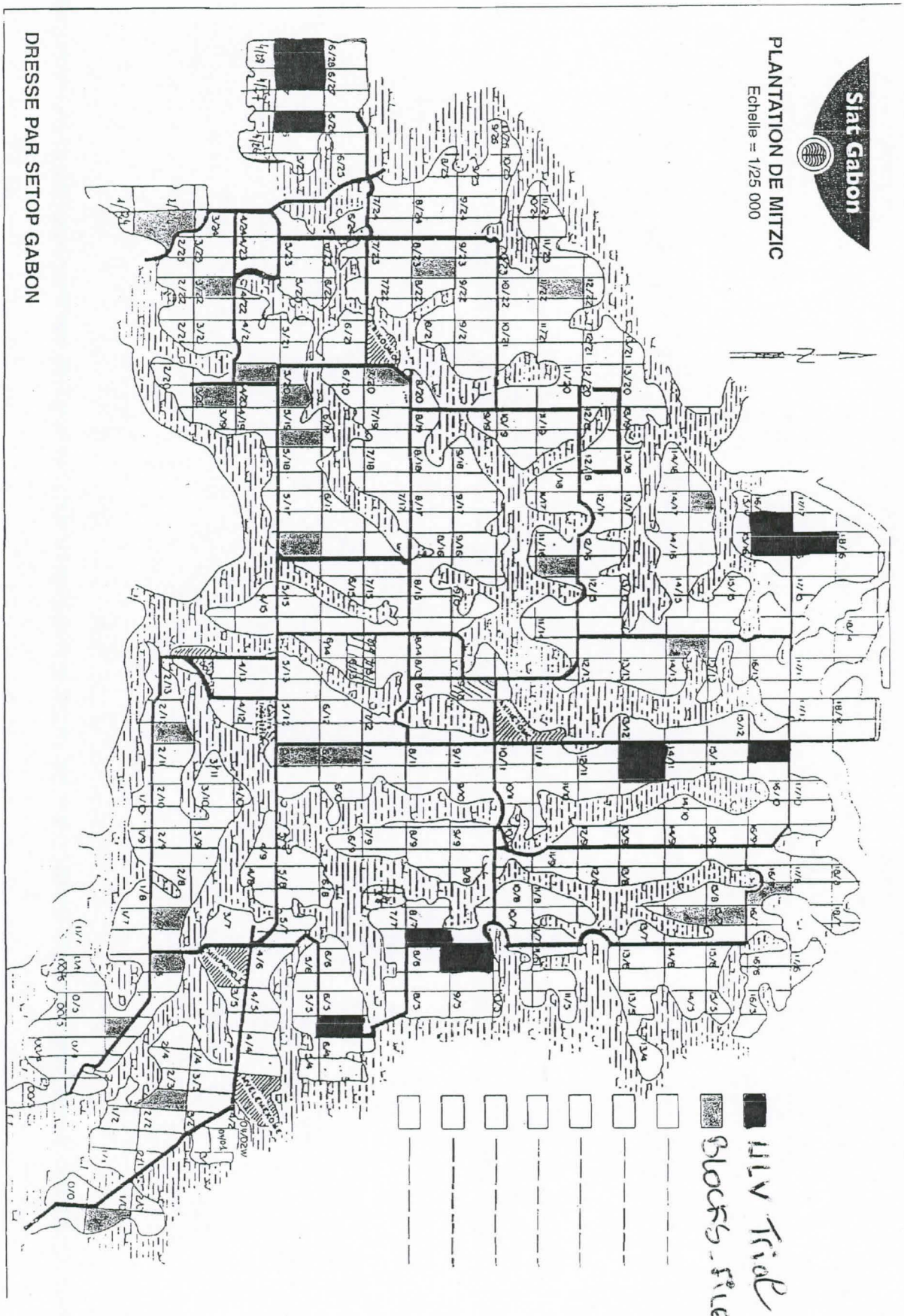
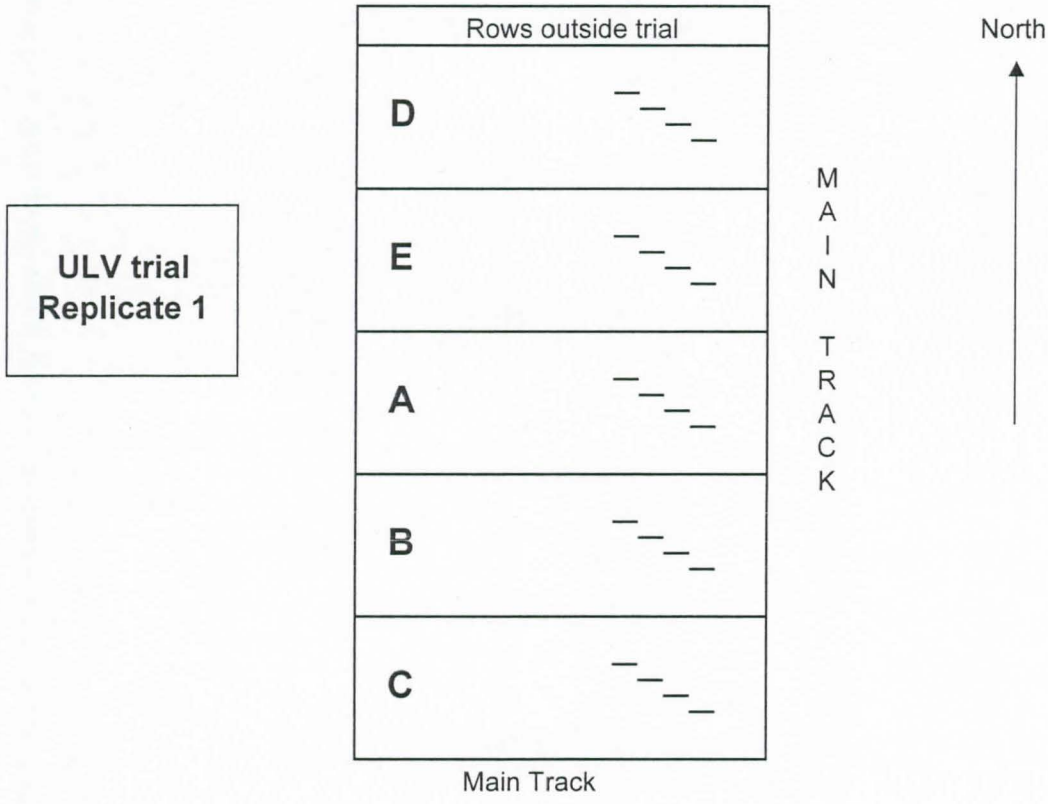
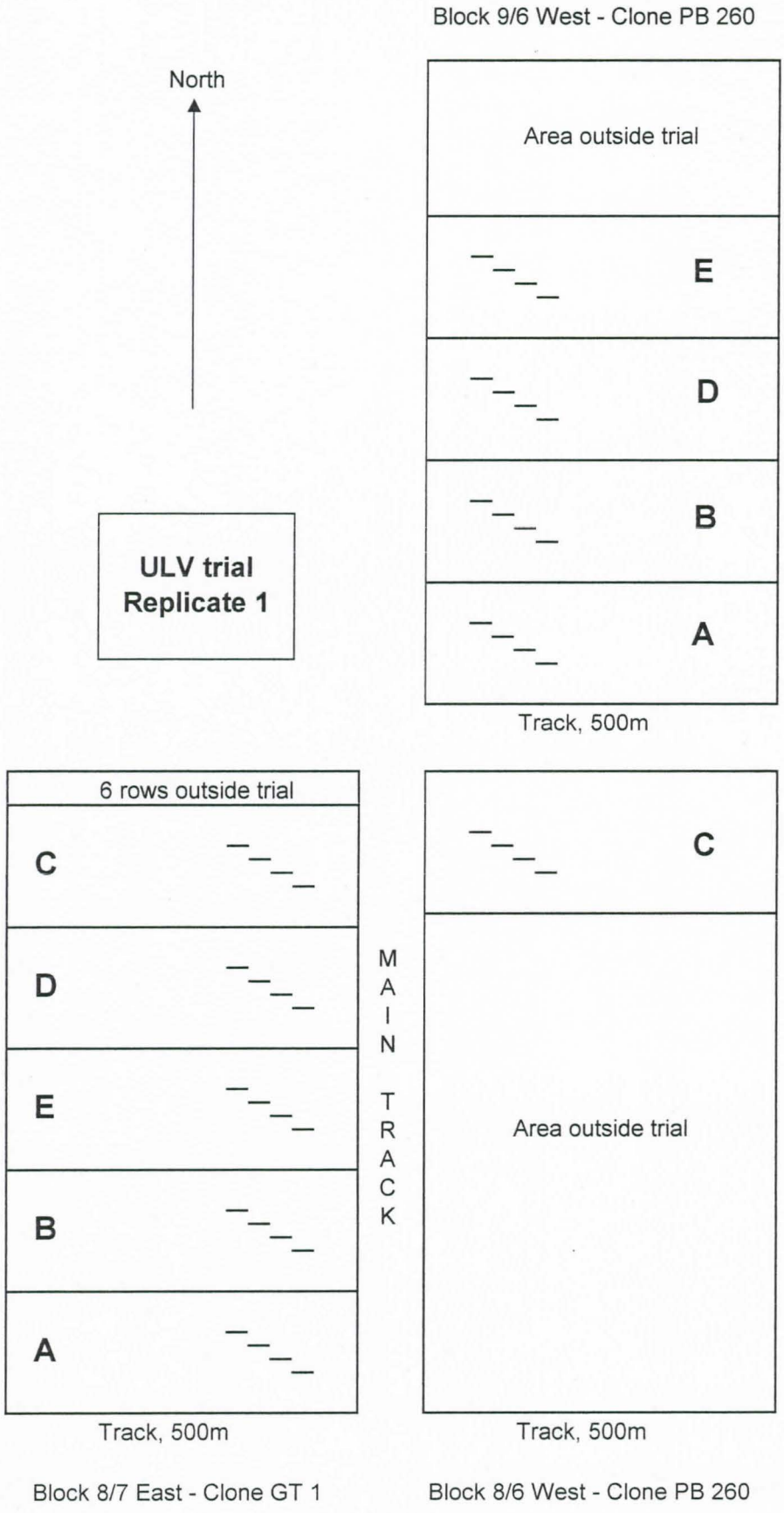
20						
21						
22						
23						
24						
25						

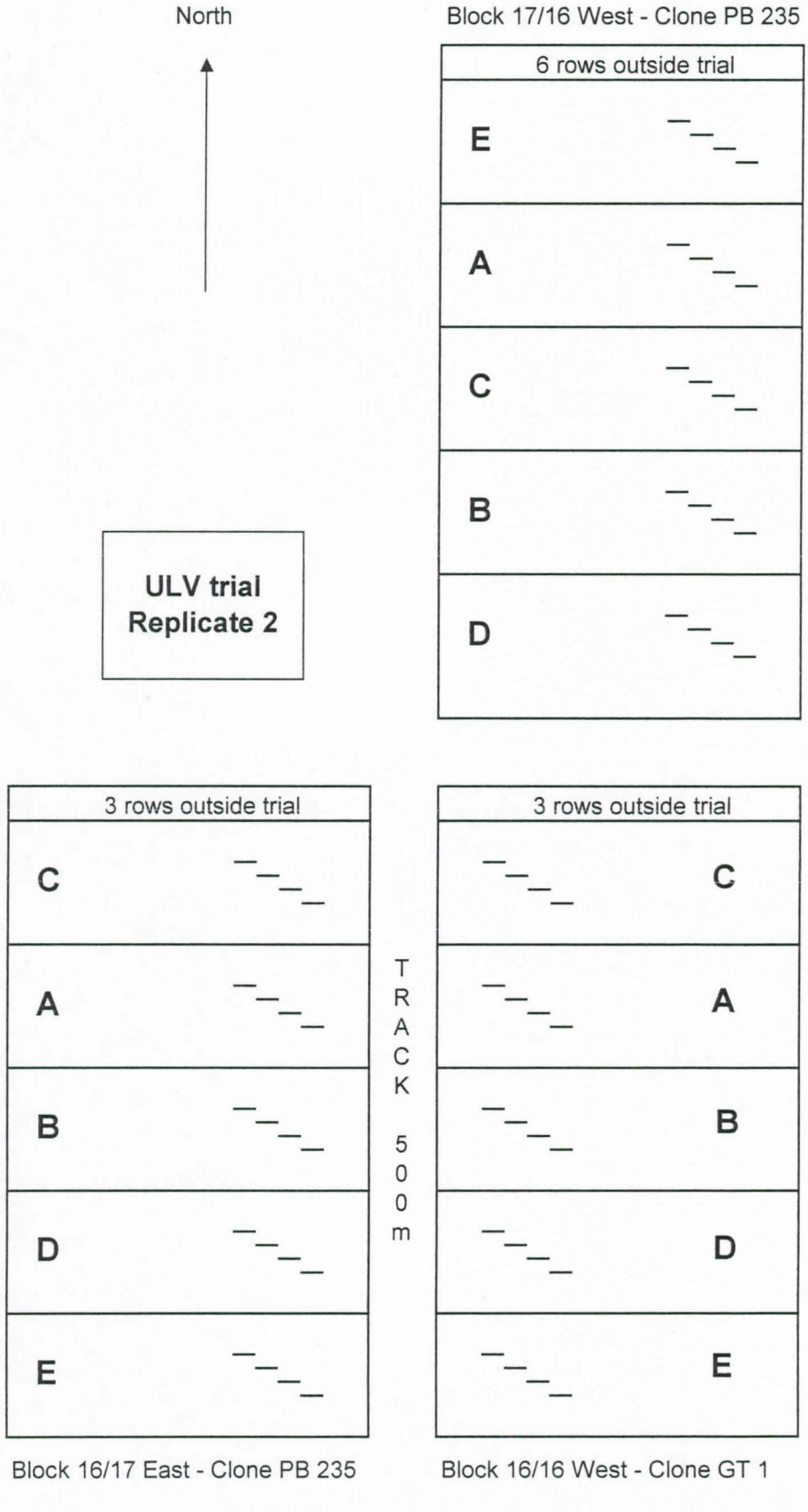
Position of ULV trial and Blocks File

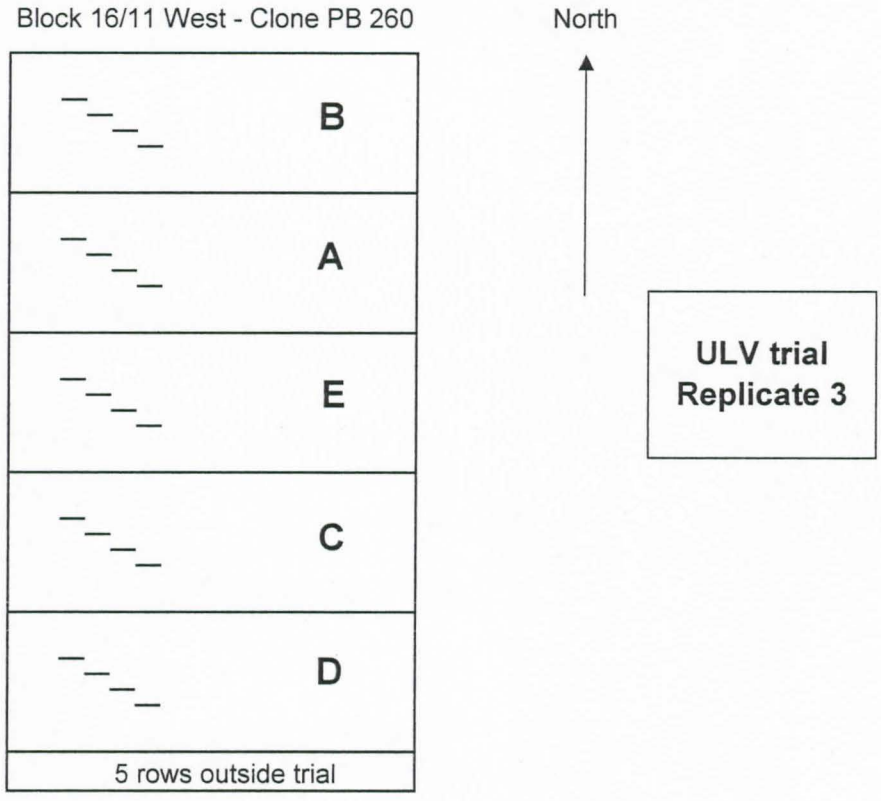


Block 6/5 East - Clone PB 235




Block 9/6 West - Clone PB 260
North
Area outside trial
E
D
B
A
ULV trial
Replicate 1
Track, 500m
6 rows outside trial
C
D
E
B
A
MAIN TRACK
C
Area outside trial
Track, 500m
Track, 500m
Block 8/7 East - Clone GT 1
Block 8/6 West - Clone PB 260


North
Block 17/16 West - Clone PB 235
6 rows outside trial
E
A
C
B
D
ULV trial
Replicate 2
3 rows outside trial
C
A
B
D
E
TRACK 500m
3 rows outside trial
C
A
B
D
E
Block 16/17 East - Clone PB 235
Block 16/16 West - Clone GT 1


Block 16/11 West - Clone PB 260
B
A
E
C
D
5 rows outside trial
North
ULV trial
Replicate 3
6 rows outside trial
C
E
D
B
A
TRACK 250 m
6 rows outside trial
C
E
D
B
A
Block 13/11 West - Clone PB 235
Block 13/11 West - Clone GT 1

ULV trial - Replicate 4